CLAIM OR CLAIMS

What is claimed is:

1. A method of chemical ligation and/or oligomerization of DNA using circular DNA templates.

2. A method of chemical ligation and/or oligomerization of deoxyoligonucleotides and/or mononucleotides using a circular DNA template as a thermodynamically stable substrate-template complex.

3. A method of producing therapeutically active oligonucleotides using small circularized DNA as a template.

4. An antigene method using natural and/or non-natural oligonucleotides for sequence-specific binding to double helical DNA using natural and/or non-natural oligonucleotides synthesized in a single chemical step accomplished under aqueous conditions using small circularized DNA as a template.

5. A method of template-directed chemical ligations and/or oligomerizations of DNA or RNA oligonucleotides and/or mononucleotides using circular templates in a single chemical step accomplished under aqueous conditions.

6. A method of non-enzymatic, template-directed ligation and/or oligomerization which is particularly advantageous for constructing non-natural, modified oligonucleotides using a circular template providing a thermodynamically stable substrate-template complex effective for chemical ligation and/or oligomerization.

7. The method as recited in claim 6, wherein short ODNs are produced with DNA templates.

8. The method as recited in claim 6, wherein the chemical reaction is adapted from linear template directed reactions but modified by circularizing the template such that the template will display recognition elements on opposing sides of the circular template for complexation with the substrates undergoing reaction.

9. The method as recited in claim 6, wherein a deoxyribonucleotide template is modified at selective backbone positions with ionized substituents which alter the overall charge of the circular template and with sterically modifying substituents or binding moieties to alter the asymetry and binding recognition capabilities of the circular template.

10. The method as recited in claim 6, wherein the circular template is formed of different monomer and/or higher multimer components as substrates for ligation and multi-ligation up to polymerization and co-polymerization for covalent bond forming reactions conducted in the presence of the circular template for controlling the reaction.

11. The method as recited in claim 6, using a small circular DNA template for highly efficient chemical ligation of ODNs using cyanogen bromide.

12. The method as recited in claim 11, wherein the reaction is conducted at a pH of about 7.5, a concentration of about 200mM $MgCl_2$ and at about 25° C.